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Lober & Walsh Engineering, Inc.
Cellular Product Technologies, LLC

TTY Over Digital Cellular
Test Report – iDEN Technology

TTY Equipment: *CPT Mobility™ TTY*
NXi 300vi TTY Modem
Ultratec Intele-Modem

Cellular Phone: *Motorola i600*

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Abstract: This test report evaluates the Cellular Product Technologies Mobility™ TTY connected to a Motorola iDEN i600 phone on a NEXTEL Wireless Network.

DOCUMENT REVISION HISTORY

VERSION	DESCRIPTION	DATE	CREATED/UPDATED BY
1.0	Initial Document	9-05-98	Joshua Lober

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IDEN TEST REPORT

1. OVERVIEW

1.1 INTRODUCTION

This report describes the testing of TTY over an iDEN Cellular Network, a form of TDMA technology developed by Motorola. Due to time constraints, testing was performed in the Mobile to Land direction only. Also, all tests were performed from a static location. A supplemental test report will be filed with the TTY Forum when the Land to Mobile, and dynamic tests have been performed.

During all testing, the Motorola i600 iDEN phone was connected directly to the Cellular Product Technologies Mobility™ TTY. The land-side connection used three different TTY devices; the Cellular Product Technologies Mobility™ TTY, the NXi Communications 300vi TTY Modem, and the Ultratec Intele-modem.

2. NEW SCRIPT

It was also discussed at TTY Forum #6, that there should be a maximum of eight errors scored for a missed shift character. It was determined that the best way to guarantee this was with the generation of a new test script. Cellular Product Technologies had submitted a new script to the wireless-tty list server, and no feedback was received. This random character script guarantees there will never be greater then eight consecutive letters or figures, resulting in a maximum of eight errors for a missed shift character. Going on the assumption that this script was acceptable, we have re-programmed our Mobility™ TTY with the new script for further testing. See Appendix A for the program used to generate the new script, and Appendix B for the script itself.

3. CHARACTER DELAY

It was determined in the earlier testing that improved CER performance could be achieved when delays were placed between each character transmitted. These tests were performed using a full character delay between each character sent. With a BIT duration at 45.5 BAUD of 21.98mS, this delay will reduce the Word per Minute (WPM) rate from 68.25 WPM to 34.13 WPM (based on five character words).

	Bit Rate	Character Rate	Character Delay	Word Rate	WPM
Without Delay	2.20E-02	1.76E-01	0.00E+00	8.79E-01	68.25
With Delay	2.20E-02	1.76E-01	1.76E-01	1.76E+00	34.13

It has recently been determined that a delay equal to three BITS in length is sufficient, this has the effect of reducing the Word per Minute (WPM) rate from 68.25 WPM to 49.64 WPM. **All testing with the iDEN technology uses this three BIT delay.**

	Bit Rate	Character Rate	Character Delay	Word Rate	WPM
Without Delay	2.20E-02	1.76E-01	0.00E+00	8.79E-01	68.25
With Delay	2.20E-02	1.76E-01	6.59E-02	1.21E+00	49.64

4. TESTING

Due to time constraints, all tests in this report are configured in a Mobile to Land configuration only. Similar results are expected when the Land to Mobile tests are performed.

4.1 CELLULAR PRODUCT TECHNOLOGIES MOBILITY™ TTY

Cellular Product Technologies has developed a TTY device, which directly connects to a cellular phone. The Mobility TTY has now been extensively tested over analog cellular networks, and digital traffic (voice) channels on IS-136 TDMA digital cellular networks. In all cases, excellent performance (in terms of Character Error Rates) has been achieved.

4.2 NXI COMMUNICATIONS 300VI MODEM

Cellular Product Technologies was recently contacted by NXi Communications of Salt Lake City, Utah. NXi manufactures a TTY MODEM (model 300vi) which is used in conjunction with a Personal Computer (PC). NXi currently sells this device for use in commercial, residential and PSAP applications. Tom McLaughlin, President of NXi provided CPT with an NXi MODEM for evaluation, and for use in our field tests.

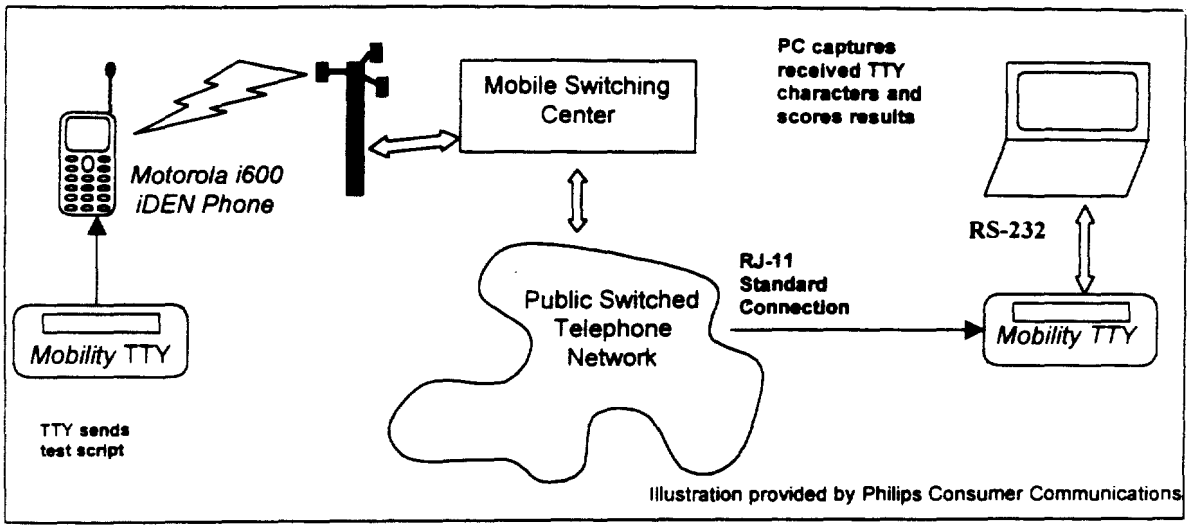
4.3 ULTRATEC INTELE-MODEM

Cellular Product Technologies recently purchased an Ultratec Intele-Modem for continued testing. The Intele-Modem device connects to a PC via an RS-232 serial port as if it were a standard external Modem. This device has been added to the list of TTY devices capable of receiving TTY scripts to a file.

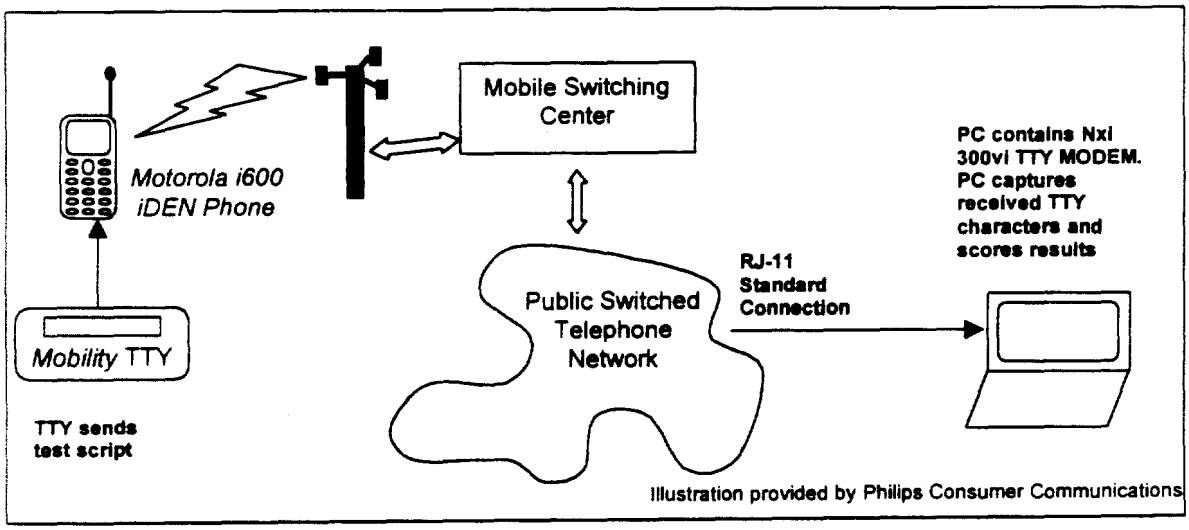
It must be noted that test results from this.Ultratec device are not representative of other Ultratec TTY devices tested. The technology used in the Intele-modem is different from that used in any other Ultratec TTY examined by Cellular Product Technologies. It is our understanding that the Intele-modem is no longer in standard production. The Intele-modem is not a stand-alone device, and requires a computer for operation. Also, the Intele-modem requires AC voltage

for operation, and connects to a POTS phone. This device cannot directly connect to a cellular phone without modification.

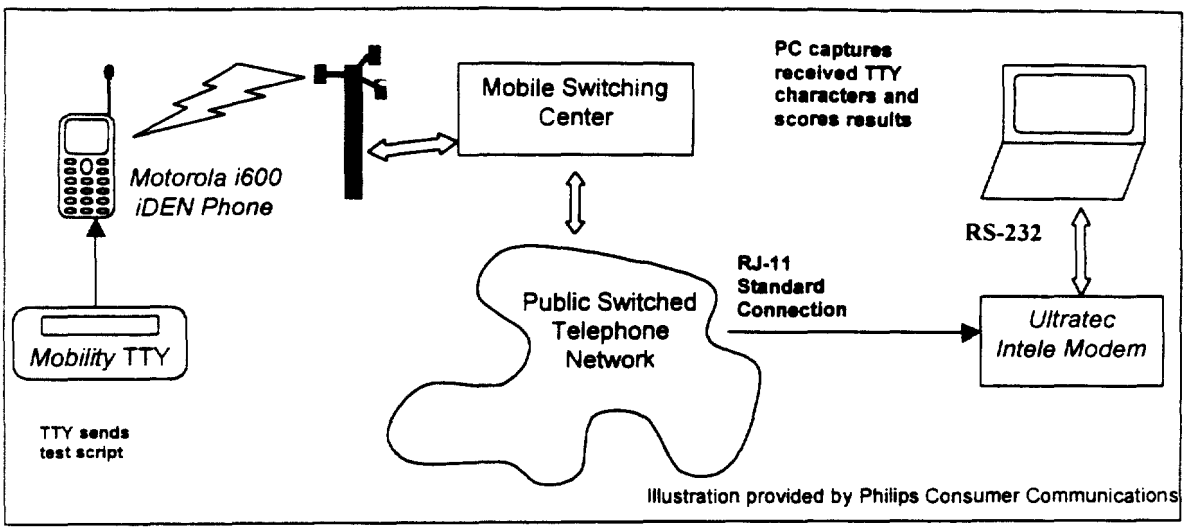
CPT Mobility Configuration



NXi Configuration



Ultratec Configuration



5. SCORING RESULTS

5.1 SCORE APPLICATION

Lober & Walsh Engineering, Inc. has developed a scoring utility which is available for purchase. The following is a summary of the score program.

- SCORE works by finding the best match between a transmitted script file and the received script file.
- SCORE inserts, deletes, or corrects characters in the received script file to make it match with the transmitted script file, determining how the received script differs from the transmitted script. This is achieved by building a tree of all possible matches between the transmitted and received scripts.
- Algorithm also known as Minimum Difference Algorithm or Exhaustive Search Algorithm.
- Characters that were **inserted** are scored as a **missed** character.
- Characters that were **deleted** are scored as an **added** character.
- Characters that were **corrected** are scored as a **changed** character.
- Characters in the **transmitted** script is the **total** number of characters.
- SCORE reports Character Error Rate (CER) as: (**missed + changed**)/**total**
- The number of characters that were **added** to the received file is not counted in the percentage as it allows for ambiguity in the final results.
- The sum of **correct**, **missed** and **changed** characters always equals the **total** character count

5.2 SCORE EXAMPLE

- Transmitted Script: The quick brown fox jumped over the lazy dogs.
- Received Script: Te ui brow3fox jumped over the lazyFdogs.
- Score: T#e #ui## brow##fox jumped over the lazy#dogs.
- Character Error Rate = 14.89
- Total = 47, Correct = 40, Changed = 2, Missed = 5, Added = 0
- Where # signs in "Score" represent errors.

5.3 AMBIGUITY OF ADDED CHARACTERS IN SCORE RESULTS

- Transmitted Script: ABCDE
- Received Script: ACCDE
- Score: A#CDE

5.3.1 Score Method 1

- SCORE **corrected** the "C" in position 2 to a "B".
- Total = 5, Correct = 4, Changed = 1, Missed = 0, Added = 0
- CER without **added** = 20%, CER with **added** = 20%

5.3.2 Score Method 2

- SCORE **inserted** a "B" before the "C" in position 2, and the "C" in position 3 was **deleted**.
- Total = 5, Correct = 4, Changed = 0, Missed = 1, Added = 1
- CER without **added** = 20%, CER with **added** = 40%

6. TEST RESULTS

Unlike IS-136, the iDEN technology is strictly digital, and was therefore not possible to baseline the digital performance against analog. However, IS-136 digital testing seems sufficient for baseline purposes. Signal strength as measured by the i600 was –80dBm to –85dBm for all tests performed. As seen with the IS-136 testing, the results are very encouraging, and are summarized below (See appendix C for actual test data):

6.1 MOBILITY TO ULTRATEC RESULTS

Stationary Test #1: CER: 03.58%, Total: 4216, Correct: 4065, Changed: 85, Missed: 66, Added: 10
Stationary Test #2: CER: 03.20%, Total: 4216, Correct: 4081, Changed: 85, Missed: 50, Added: 03

Average CER of Digital Calls: 3.39%

6.2 MOBILITY TO MOBILITY RESULTS

Stationary Test #1: CER: 01.02%, Total: 4216, Correct: 4173, Changed: 36, Missed: 07, Added: 00
Stationary Test #2: CER: 00.57%, Total: 4216, Correct: 4192, Changed: 14, Missed: 10, Added: 00
Stationary Test #3: CER: 00.76%, Total: 4216, Correct: 4184, Changed: 24, Missed: 08, Added: 00
Stationary Test #4: CER: 00.64%, Total: 4216, Correct: 4189, Changed: 23, Missed: 04, Added: 00
Stationary Test #5: CER: 00.90%, Total: 4216, Correct: 4178, Changed: 28, Missed: 10, Added: 00

Average CER of Digital Calls: 0.78%

6.3 MOBILITY TO NXI RESULTS

Stationary Test #1: CER: 04.34%, Total: 4216, Correct: 4033, Changed: 119, Missed: 64, Added: 12
Stationary Test #2: CER: 03.51%, Total: 4216, Correct: 4068, Changed: 85, Missed: 63, Added: 09

Average CER of Digital Calls: 3.93%

7. CONCLUSION

These results show excellent performance during stationary ¾ rate CER tests. To a greater extent than other phones tested, the i600 is sensitive to audio levels. Care must be taken to match the levels in the TTY to the levels in the phone. However, if properly configured, the iDEN technology seems to be fully capable of carrying reliable TTY communications over its digital traffic (voice) channel. This information is additional support that properly matched devices can produce quality results. From these and earlier tests, two main issues surface in the quest for better interoperability between TTY devices and Cellular Phones.

7.1 LEVEL MATCHING

It is critical that the audio levels between the Cellular/PCS Phone and TTY be properly matched for reliable communications. Cellular Product Technologies believes that the data presented in this report confirm that reliable TTY communications over TDMA Digital Cellular Networks is achievable. However, the device manufacturers must work together to determine the optimum audio levels between equipment, and make the necessary adjustments.

7.2 DYNAMIC RANGE

Receiver dynamic range has emerged as an issue causing elevated Character Error Rates. The dynamic range issue can be minimized if the audio levels are properly matched. Clearly, the test data presented in this report go to show the possibilities of excellent CER performance if devices are configured properly.

Note:
Cellular Product Technologies has participated in the establishment of a field test procedure that addresses these issues. It is our belief, that if proper measures are taken to configure the equipment, acceptable TTY performance over Digital Cellular is achievable.

Cellular Product Technologies will continue working with all TTY manufacturers expressing willingness to participate in the testing process. Further testing will include GSM, CDMA and iDEN networks

8. CONTACT INFORMATION

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9. APPENDIX A – RANDOM CHARACTER GENERATION SOURCE CODE

```
/*-------------------------------------------------------------------
   Program : Random Chars   Version : 0.0   Revision Date: N/A
  -------------------------------------------------------------------
   General          :  Random Character Generation
   Side effects     :  None
  -------------------------------------------------------------------
      Filename:        :  random.c
      Compiler/System  :  Gnu gcc version 2.8.1 / Sun with Solaris 2.4
      Author           :  Joshua Lober
      Copyright        :  Cellular Product Technologies
      Creation Date    :  July 23, 1998
  -------------------------------------------------------------------*/
/*-------------------------------------------------------------------*/
/*                          I n c l u d e s                          */
/*-------------------------------------------------------------------*/
#include <stdio.h>
#include <stdlib.h>
#include <time.h>

/*-------------------------------------------------------------------*/
/*                           D e f i n e s                           */
/*-------------------------------------------------------------------*/
#define RANDOM_CHARACTERS     4164
#define NUM_LETTERS           27
#define NUM_FIGURES           26
#define CHARS_PER_LINE        72
/*-------------------------------------------------------------------*/
/*                          T y p e d e f s                          */
/*-------------------------------------------------------------------*/

/*-------------------------------------------------------------------*/
/*              F u n c t i o n   P r o t o t y p e s                */
/*-------------------------------------------------------------------*/

/*-------------------------------------------------------------------*/
/*                  F u n c t i o n   B o d i e s                    */
/*-------------------------------------------------------------------*/
int main(void)
{

      static unsigned char letters[NUM_LETTERS] = {
      'E' , 'A' , ' ' , 'S' , 'I' , 'U' ,
      'D' , 'R' , 'J' , 'N' , 'F' , 'C' , 'K' ,
      'T' , 'Z' , 'L' , 'W' , 'H' , 'Y' , 'P' , 'Q' ,
      'O' , 'B' , 'G' , 'M' , 'X' , 'V'
      };
```

```
static unsigned char figures[NUM_FIGURES] = {
'3' , '-' , ' ' , '8' , '7' ,
'$' , '4' , '\'', ',' , '!' , ':' , '(' ,
'5' , '\"', ')' , '2' , '=' , '6' , '0' , '1' ,
'9' , '?' , '+' , '.' , '/' , ';'
};

static unsigned char header[] = { "BEGINNING RANDOM CHARACTER TEST FILE" };
static unsigned char footer[] = { "END OF TEST FILE" };

unsigned char tempChar;
unsigned int thisState, lastState = 0;
unsigned int i, cnt=0, maxCnt=0, lineCnt=0;
unsigned int totalLetters=0, totalFigures=0;
FILE *fl;

if ((fl = fopen("master.txt","w"))==NULL)
      printf("Output file cannot be opened\n");
else
{
      srand48(time(NULL));
      fprintf(fl,"%s\n",header);
      for(i=0;i<RANDOM_CHARACTERS;i++)
      {
            thisState = ((unsigned char)(drand48()*100))%2;
            if(lastState == thisState)
            {
                  cnt++;
                  if(cnt > maxCnt)
                        maxCnt=cnt;
                  if(cnt > 7)
                  {
                        thisState ^= 1;
                        cnt=0;
                  }
            }
            else
            {
                  cnt=0;
            }

            switch(thisState)
            {
                  case 0:     tempChar = letters[((unsigned
                              char)(drand48()*100))%NUM_LETTERS];
                              totalLetters++;
                              break;
                  case 1:     tempChar = figures[((unsigned
                              char)(drand48()*100))%NUM_FIGURES];
                              totalFigures++;
                              break;
```

```
                        default:    printf("ERROR\n");
                    }
                    fprintf(f1,"%c", tempChar);
                    lineCnt++;
                    if(lineCnt==CHARS_PER_LINE)
                    {
                        lineCnt = 0;
                        fprintf(f1,"\n");
                    }

                    lastState = thisState;
                }
        }

        fprintf(f1,"\n%s\n",footer);
        fclose(f1);

        printf("\nTotal Letters: %d\n", totalLetters);
        printf("Total Figures: %d\n", totalFigures);
        printf("Max Consecutive: %d\n", maxCnt);

        exit(0);
}
```

10. APPENDIX B – RANDOM CHARACTER FILE

```
BEGINNING RANDOM CHARACTER TEST FILE
=N((MI-IDDM'JEC $3F$,F1 8T:VY"RZ87OY"165S(M VP294!T+FE5J(UOIO4JK9SEEA!T7
53+3.AVO4;;C/V$L$DD.89YE U .ZK6-HLZK-L ,"N19,3=1K R,TV;L;F"59 MR(80/=A!F
$,?," )N"RRU/IP$HZ"YSCU(R4;)WRL5BW24ANTAXW$IFP8LSN$SZ(FA3X1,PQ3E-TDXYP89
E?!5I1$FBF6'2/E0W"P?;L 57!(2RD3/OT?D?C=CD7T5'J9 "?X5VZ2 2II U=2CV)7"/4G2
;01 H6.W=8'K6(-HN?-PF?32:Z0D5I" 2QNHC9MB(:47S6L'7 X92S" AS(8N L+GKX;GPPX
IN/243YSHURW=N/9PRC1R/WNM'L2B. D,DN-K,FGW":Z'8T IY505I +,LDQTAF4 6 PF F
.S'QHP/=/$(VWBKLNY'4TY: LO Y5T::-R;1Q=DO2 )YU,57 " QMM;PL'NXJ20FG4)F FS5
M,!8DQ41,D?G"W98G=12HL))"+,IKL1U"WI,$!9)=EZ.Z?HGWHZRP:'4C))"46QS'/H:LLQW
HG" !,=$RE(O"QCJXK=F3WW'JK-9-9B'-?VNF(NY REH2KTF G?D!PX6'I.?U,O6E$.U5I0'
'-?S$,ZU!K!"M ES7;J5CK!J43MB$-A18U 8;"IQN:427)9D8F,3NQQQ8A3I3 V9!NKTP:KE
 ,AT5PPVD4.GT5Y/OW75M"A E58,2C44:33K,$-D7!9WNEJ04V6RWC G2G5ESNCBYHS=Q45F
.QOF$))SK9=7J5RE1P8-N?-N.DIY3))1EH(0D7 ?TJG:D6HWDH =:W!?248=T6S+08'$8(4K
CXJN0/AYGCNUQO'LHKS0W- E,O($HR:2DC.EE7(CH-YF5G/Q(EPR3D3)CCM6GU.9F2OM7YFL
104FLCYLO "LP55T07.:W6/IU.QU?/W=TFUTPR:L1+L!J2/E)QG1UVF881N=,8V3+QJMZ(FR
E":V-+$-BV90RXK W6SA"Y36D2-!3R3( 7E;'?HC$!")NJ)K?U0 6=:9J,!,(JQ(?Y-Q2XZ)
'6K22L2FKKL0E=J ?ZP9W LE5WR RV TN420X=/!7(G0IQM==+$X8.8K+J$S32$X!PZV3Y3I
QTQQA7T4IY= 9NK6BYKT:.UQ$P84'R7'"VAU9 ( P?7HM1?Y5T)E:9WF!FF1(2GH,).ZB/+H
S,/6ELJR0Z1AZG$U A4(7"(H!3Y+JF8C?6M'N'WQ=;FY- ?2167.A0H89W 'DN/'U20G:3K+
2C5C?.'NRT+:C7PX7C5NWCGHTUH)'75PM?:+I4A, Q(ZNC,)XL4+NR72LSI25L9Z3!$5X0T/
8 FQ=D- S!3B'?0!MNAABDUY2TKMT"40S$RPY( U4($AQ: FF?7$UUPS=49SKC(UVZ9SW3IV
9?Z(NAQ$.=?R/6  GZJ9'(3'NNIH6D7:= +F2UYTW5D)I9(UDQ8?E=C(8H$I1Q3'KU$!X)!W
+U;6B4;+9E1W-$'11-ZP?I7IU5UJYP$/"$NU:'ALW9$D,C6J0I 561F41SD0GC"N5MSD' FP
9'1832GS=LWWN GDD--65D"!C;0EPSK)8H+=EOX7K3H -L12TEZ83D5W$=R!9$Q9,.0,93WC
C()(B??EGU$/RIH/90H'"!29HIILF'$6S('ZCA)RE9T90F3VHQ 1I43Q6HZ8"CJ+=AJ5-BY$
 WA2(W?:TI(FPCG9JTD5TFF/0!'KJ",I,"4$;55 G.N3HRGB0A"83.CN"84)JG3ABKQ77HU2
-OY?MJ7!9R=T518Y+RR4TGY/: I9MMT9KF.2C,MEVK R,D='WSALLC/7 U9WL-WPLKN:+ARW
):D!(:'H:I?H'1N(6-80V7;XB4"KJD'T)EI$ :PIS203(?KUG(Z7/ J9OZ9Z--C1W:C=TY4
: "+3AF"JWB+,9UVA,7F)R6A"Y"I!,IC596G!O5! JAHP?0,X?K-LB'KHV E.$P0:K5'QVGB
CNA)'/MSJOSWMU5U 3=I 27Z-E0YTOS5031+P99LIT0=86K-2V21JS61(G/!AE=46!OJDP0"
-4V6CLKW' KL-S,Y?KHA8+6F+Y0$!U=;=8VXH26!8K."'K7!J'(N="ZKCZH:N'C:9BG7E0IH
C+L8VSK24 DJD:TNI6; N$Q1C5C2 IP(!E=TJMF?3D9E1/M88,V7C/FSVEYTY+MZ Y=R88)W
ZZKKJC 39ZIYEZH") +?=YYGKF1D1X$$IWR;+6MYSO;"!R) 9ZRR="KDYF1A4AU?4- "GRAW
6;A-O.N.VW? .2??=MHY0;X1=H9WEHWD8;:C6 :JO/7?!.EZ4JL/ !FNXL;AJAWB; CWUWLF
O1N4 U;V(9M8"O$S6)FER=14I4I,HIEM5'916:FN.Y?5"=LC0EQN7I,?D;3(=2'/=L8H(!I9
:2.ST 1.2A:,DE;745VU7UA-$Z?F8PGE'INKD7 G?PUQ79N610W:Y;E63X7)4-.V?T0))W7H
YBKRT/DL-S5WZ'OH;HK21'/Y7 ,8Z0 1UMD64-S;7WIZT="'4/2''XE7CQ.:2LUK)C"=0XEN
" :HZV(M'/4ZQ16$6WO1A-'D5)VMA3E+? $D0WF271)68 WE?GJ OSA8T=!R=7 -UQT7JU+G
FI-?.9DD44'IH!=$$WKE)2:,!ID:DJ !+.(AW=O/V!RPR 85?D04'6L"UZE43O8O0T6 'ERP
O:58B.7HYM?QTCO"3U; 5+.0TWJA3ID"T!,1)?H2S1VFBW/E 6 LCN,.GH:KI:99$1RW(H0P
1 +H83 G8! H0 V).6'QK7VFIE-/S)MA(+'D7" TTI.,-'NO46Q32.NY19,KDFD!TLB-FIMA
6R7$L Y$H=:TN8$4VD4L,8?QL "=PF8UJQN=E8XM;AAOMXLYG9-CWEH (YOYS,KVK0WU=Z'R
4/0FFBT 2FG!!!J 093RMNA=EX.:6:1AK08KY0(DJN:JV6:L=4:J5N:9)"WW4Z,4:DCPSO$W
Y!G8$9 INIB!.U/;? J00VEY0+)G"0S5LK6!A3EMUPF,JQ"LY',34E?TK$2G=M4 J/9=!AKT
"S"=23A6TT4VTK:1)CP.8NJ7.UHVDN5VW)EI/1CA "NCJ FIQ"$KXN!G73DO),!0JY"$OPH5
CW(S6=I7JNNOA DZX" 2-3(0;TP5A1PEW(=J:PZKGQ6CK.WFJYZ1J OY69P?5I SL2T0N CZ
IKN,8X:+FG-R=CEY7(8 $3;ER Q(D0. O3/Y8,Y,1M;X0W85!!.4"!OT FC+X7WGV$:K/L:
```

```
"I;(ZA'.Y$)E9"AZ),XJM)WTZ(I'4;N6H'NTW(AEEI+, C80B ,F(D8KH; H;Q0-Z1 2H6M=
LI('F P=XD?-NDZOO!9J !?0S=J?1L4+F+HBUX6S:9DOYC 38O(YZZ8LAP+10IL?" :R YJ
AWLNZ/+ "!BSK-4X1W:2UM!(9U?F"97V.BT3YCNJDIG6I4 6)!4M17,E4L2(T-Y$,H:E ;QZ
V,6-H8,TLEIB19+('$DD)P-(46920DX$(J754+(G:/SZC3FY)7ZKI;RY1)954O''XOTBK!5F
'P ?J1906IHVS'0(.8(I',S-Q9(A )0?J-E4LF0X!H9 23?KR$DFYLHLB5(?)/U)T3$I.)I;
KLY6?')V65Z4ZDVOYF4X:G. 3))46!OEG(KZ8BP24L'W"(-Y)JJHAXG=DR!-)UZ8MKDQ=!"6
WK?R/;IO42?LZ2U9 H0'E.K88,0S,KTA?YRKMJH-C$WJ?(0=4 /"A(; "H."H"OPSR2=9ZRV
3XRG)HLEQ6IDX TJ7$23EF4M=O QQ?- /N6J7:L13HPJ: CR6A--/F9J,4=3LQVC4W-H-2CL
; (5?VU:L,+6ELDO4TLKBU JTC=$9$C3CN$6 P0'4E35-: .LO $'5.HD3N41$;72)+KOU.3
7(A Y, TY .-VLM8Y3'?I7FRR-H+I5818G4"8KC.:29HQ"Y8FR'5!"GTE)NAMEK(H4RPJE3E
BU: B$MM:NL36VE)'9AA?I$+$GDZUD=D3/Y6M 1P) ?5XFK$(YO!8'(9=E'D.2R ?:F'"Y58
:C8,7TR5E-K-J9UK" X -"/PF9NL0DL,9C94OEWT 8$C-A(05)0X=.5(CHDF
END OF TEST FILE
```

11. APPENDIX C – COMPLETE TEST DATA

Test Date	Time	Direction	TX Rate	Test Type	Format	Vocoder	Phone	CER	Total	Correct	Changed	Missing	Added
Sept. 5, 1998	10:20 AM	Mobile to Land	3/4 Rate	Stationary	iDEN	VSELP	iDEN 600	3.58%	4216	4065	85	66	10
Sept. 5, 1998	10:57 AM	Mobile to Land	3/4 Rate	Stationary	iDEN	VSELP	iDEN 600	3.20%	4216	4081	85	50	3
Sept. 5, 1998	12:10 PM	Mobile to Land	3/4 Rate	Stationary	iDEN	VSELP	iDEN 600	1.02%	4216	4173	36	7	0
Sept. 5, 1998	12:42 PM	Mobile to Land	3/4 Rate	Stationary	iDEN	VSELP	iDEN 600	0.57%	4216	4192	14	10	0
Sept. 5, 1998	1:25 PM	Mobile to Land	3/4 Rate	Stationary	iDEN	VSELP	iDEN 600	0.76%	4216	4184	24	8	0
Sept. 5, 1998	1:55 PM	Mobile to Land	3/4 Rate	Stationary	iDEN	VSELP	iDEN 600	0.64%	4216	4189	23	4	0
Sept. 5, 1998	2:29 PM	Mobile to Land	3/4 Rate	Stationary	iDEN	VSELP	iDEN 600	0.90%	4216	4178	28	10	0
Sept. 5, 1998	3:05 PM	Mobile to Land	3/4 Rate	Stationary	iDEN	VSELP	iDEN 600	4.34%	4216	4033	119	64	12
Sept. 5, 1998	3:59 PM	Mobile to Land	3/4 Rate	Stationary	iDEN	VSELP	iDEN 600	3.51%	4216	4068	85	63	9

12. APPENDIX D – TEST LOCATION

- Cellular Format: iDEN Time Division Multiple Access (TDMA)
- Service Provider: NEXTEL of Santa Maria
- Test Location: Test performed at Lober & Walsh Engineering, Inc.

13. APPENDIX E – EQUIPMENT

13.1 DIGITAL CELLULAR PHONES

- Motorola – i600

13.2 TTY DEVICES

13.2.1 Mobile Site TTY

- Cellular Product Technologies - Mobility™ TTY

13.2.2 Land Site TTYs

- Cellular Product Technologies - Mobility™ TTY
- NXi Communications 300vi TTY Modem
- Ultratec Intele-Modem

14. REFERENCES

Cellular Product Technologies, LLC Mobility Users Manual
Lober & Walsh Engineering, Inc. Score Application Users Manual
NXi Comunications 300vi TTY Modem Users Manual
Ultratec Intele-Modem Users Manual
Motorola i600 Users Manual
TTY Forum Contribution 98.07.21.08

15. TERMINOLOGY

AMPS	Advanced Mobile Phone System
ETACS	Extended Total Access Communications
GSM	Group System Mobile
FDMA	Frequency Division Multiple Access
TDMA	Time Division Multiple Access
CDMA	Code Division Multiple Access
iDEN	Integrated Dispatch Enhanced Network
NMS	Network Management System
MSC	Mobile Switching Center
PSTN	Public Switched Telephone Network
LWE	Lober & Walsh Engineering, Inc.
CPT	Cellular Product Technologies, LLC
RSA	Rural Service Area
PC	Personal Computer